Claim Rejections Under 35 USC § 112

Claims 38 and 57 stand rejected under 35 USC § 112. The examiner states:

> the specification does not reasonably provide enablement for providing a symmetric flow to vector the primary flow. Symmetric flow by definition cannot provide vectoring. The specification does not enable any person skilled in the art to which it pertains or with which it most nearly connected to make a or use the invention commensurate with the scope of these claims.

The applicant respectfully submits vectoring comprises altering the direction and magnitude of the primary flow. Asymmetric flow vectors the primary flow by the directing of primary flow from its original flow axes. Symmetric flow vectors the primary flow by throttling, i.e. (affecting the magnitude) of the primary flow. Therefore the applicant respectfully submits that symmetric flow can provide vectoring in the form of adjusting the magnitude of the primary flow.

Claims 31-33, 35-38, 75, 76 and 78 stand rejected under 35 USC § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention. The examiner states:

> the claims are indefinite because there is no structure defined for the primary flow in which a throat or sonic plane should necessarily exist. There is no nozzle, conversion portion, diversion portion, throat, et cetera defined in claims.

The applicant respectfully submits that amended Claim 31 states that the primary flow is through a "convergent portion of the three-dimensional (3D) small area expansion nozzle." Furthermore, amended Claim 31 states that the convergent portion of the small area expansion nozzle is located upstream of the effective throat or sonic plan and that a "divergent portion of the 3D small area expansion nozzle" is located downstream of "the primary injector."

Claims 31 and 57 have been amended to overcome the rejections under 35 USC § 112. Therefore, applicant respectfully submits that Claims 31-33, 35-38, 57, 75, 76, and 78 have been amended appropriately and Applicants respectfully request the Examiner withdraw the rejections and allow Claims 31-33, 35-38, 57, 75, 76, and 78.

Objections Under 37 CFR 1.75(c)

Claims 42 and 61 stand objected under 37 CFR 1.75 as being of improper dependent form for failing to further the limit of the subject matter in a previous claim. In respect to Claims 42 and 61 the applicant respectfully submits that these claims are cancelled.

Double Patenting Objections

Claims 31-33, 35-38, 51-57, 59-62, and 75-77 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatenatable over claims 1-46 of U.S. patent No. 6,112,512. Applicant respectfully traverses the Examiner's assertion under the judicially created doctrine of obviousness-type double patenting.

The applicant respectfully submits that the independent Claims 1 and 26 of U.S. Patent Nos. 6,112,512 provide a control system for vectoring the primary flow. The applicant respectfully submits that as amended independent Claims 31 and method Claim 44 provide a three dimensional small area expansion nozzle within which the primary flow is vectored by varying an effective throat or sonic plane (in cross sectional area, shape, and orientation) within the primary flow. Thus the applicant submits that U.S. Patent No. 6, 112, 512 provide the control system for vectoring the primary flow while independent Claims 31 and 44 of the instant application provide a three-dimensional small area expansion nozzle operable to vectoring the primary flow and method for vectoring the primary flow in the three-dimensional small area expansion nozzle.

Claims 78 and 80 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over 1-46 of U.S. Patent No. 6, 112, 512 in view of either Terrier or Justice. The examiner states:

> U.S. Patent No. 6, 112, 512 does not teach the 3-D or ultra high-aspect ratio biconvex or trapezoid aperture nozzle. Terrier teaches (Fig. 8) at ultra-high aspect ratio biconvex aperture (3-D) nozzles are old and well known in the fixed nozzle art. Justice teaches that it is old and well known in the fixed nozzle art to employ a 3-D ultra-high aspect ratio trapezoid aperture nozzle 33D (Col. G, circa Line 63). It would have been obvious for one of ordinary skill in the art to employ a 3-D nozzle as taught by either Terrier or Justice as well known types of fixed nozzles utilizing in the art."

The applicant respectfully submits that the instant application can be distinguished from the prior art of Terrier or Justice by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area and orientation of the effective throat. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier, rather only a steady state injection into a primary fluidic flow. Thus, Terrier or Justice, in fact does not disclose and teaches away from the unsteady fluidic pulse of the present invention.

Applicant respectfully submits a timely filed terminal disclaimer in compliance with 37 C.F.R. 1.321(c) is provided to overcome the rejection based on non-statutory double patenting as Patents No. 6,112,512 is commonly assigned to Lockheed Martin.

Therefore, applicant respectfully request the Examiner withdraw the double patenting objections and allow Claims 31-33, 35-38, 51-57, 59-62, 75-78, and 80.

Rejections Under 35 USC § 102

Claim 80 stands rejected under 35 USC § 102(b) anticipated by Terrier 5, 664, 415. The examiner states:

> "Terrier teaches a system for vectoring primary flow comprising: A 3-D nozzle (see page 6 section on whether 3-D nozzle aspect is readily apparent) having an inner service and a throat, wherein the throat comprises a region within the 3-D nozzle of lowest cross-section area, the throat being in a path of primary flow of fluids; a plurality of primary injectors arranged along the inner surface of the 3-D nozzle, the plurality of primary injectors 24 are individually arranged to oppose the primary flow of fluid in a first intended vectoring plane, and wherein said primary injectors skew an effective flow or sonic plane within said 3-D nozzle."

The applicant respectfully submits that amended Claim 80 injects fluidic pulses with the plurality of primary injectors. The applicant respectfully submits that the instant application can be distinguished from a prior of Terrier by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area of the flow. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier, rather only a steady state injection into a primary fluidic flow. Thus Terrier in fact does not disclose and teaches away from the unsteady fluidic pulse of the present invention.

Therefore, applicant respectfully request the Examiner withdraw the rejections under 35 USC § 102, and allow Claim 80.

Rejections Under 35 USC § 103

Claims 31-33, 35, 37, 38, 40-42, 51-57, 59-61, 75, 77, 78, 80 stand rejected under 35 USC § 103(a) as being unpatentable over McCullough (3,698,642) in view of either Ernst (3,294,323) or the AIAA paper of Miller et al (AIAA 95-2603). The examiner states:

> McCullough teaches a nozzle having a primary flow, a primary injector, and a secondary injector 18, and valve controller 22 is to direct the flow to where the effective throat area of the nozzle and perform thrust vectoring (top of column shoe). McCullough further teaches the use of fuel (Col. 2, Lines 26-28). Alternately for the controllers it is clear that the valves require a controller to actuate them. It would have been obvious to one of ordinary skill in the art to employ a controller in addition to the valves in order to provide the necessary control over the thrust spectrum and/or throat control. McCullough does not teach the primary and secondary injectors are inclined to oppose the flow. Ernst teaches that it is old and well known in thrust vectoring art to employ primary and secondary injectors one, three that are either angled perpendicular to the primary flow or inclined to oppose the flow (Fig. 3) and shows that the effective vector O can be increased by using opposed flow (Fig. 3 to Fig. 1). Miller et al teaches a fixed geometry exhaust nozzle used for gas turbine/turbofan engines (which inherently employ compressors) where the nozzle area is varied by a cross-flow injected in the upstream direction (Figs. 2-5) in order to achieve a variable throat area. At the throat the primary flow reaches a sonic condition. Nolan shows on the coversheet of the paper that the flows from the primary and secondary injectors can be angled to oppose the flow. Miller et al further teach very low injection angles are possible (see top left of Fig. 9) and hence as angles are very low, the angles will also be approximately parallel to the vector angle, which would also be low. It would have been obvious to one of ordinary skill in the art to decline the injectors of McCullough to oppose the flow, as taught by either Ernst or Miller et al, in order to enhance the effectiveness of the thrust vector and/or to employ an alternative means of vectoring well established in the art. As for using the nozzle with a jet engine aboard an aircraft, this is taught by the Miller paper. It would have been obvious to one of ordinary skill in the art to employ the nozzle with a jet aircraft, as a well known application of such a nozzle. As for the nozzle being a three-dimensional nozzle, any nozzle can be considered in its broadest sense a 3-D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, et cetera, caused deep mediations from an idealized case. As for the temperature being controlled by decreasing the cross-sectional area, this is inherently done as evidence of Bernoulli's theorem.

With respect to McCullough the applicant respectfully submits that McCullough teaches to control the effective throat of the nozzle with shock waves which form a gaseous, non-structural throat. (McCullough: Col. 2, Line 3-6) Although the examiner states that there is no requirement that the secondary injector of McCullough be located downstream of the throat. The applicant respectfully submits that the non-structural throat 24 is created by shock waves. McCullough fails to teach that injected flow may be pulsed as claimed in amended Claims 31 and 57. Additionally, the Applicant respectfully submits that the injectors of the present invention can be distinguished from those taught in McCullough in that the injectors of the present invention are inclined at an angle to oppose the primary flow, as stated in Claim 31 and 57, while the injectors taught by McCullough are normal to the primary flow, as shown in Figure 1. (McCullough: Figure 1, and Column 2, lines 40–50).

With respect to Miller, the Applicant respectfully submits that Ernst and Miller, et al. fail to teach the use of an injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in independent Claims 31 and 57.

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from the combination of McCullough and Ernst or Miller. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35, 37, 38, 40-42, 51-57, 59-61, 75, 77, 78, 80 as being unpatentable over McCullough in view of either Ernst or Miller et al., and allow Claims 31-33, 35, 37, 38, 40-42, 51-57, 59-61, 75, 77, 78, 80.

Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, and 80 stand rejected under 35 USC § 103 as being unpatentable over McCullough in view of either Ernst or the AIAA paper of Miller, et al as applied above and further in view of Kranz, et al (U.S. Patent No. 4, 351, 479) or Warren (U.S. Patent No. 3, 204, 405). The examiner states:

> "McCullough teaches various aspects of applicant's claimed invention but does not teach flow as pulse. Kranz, et al teaches jet engine nozzles 7 having a plurality of injectors (a-f) spaced about the housing, and having controllers 36 associated with injectors, the controller directing the injector to provide an unsteady, i.e. pulsed, fluidic cross-flow. The pulse cross-flow is injected to control the effective flow area, throttle and also vectoring the primary fluidic flow (see especially Col. 5, Lines 9 and following). The pulse cross-flow partially blocks the opening of the nozzle and can either be symmetric (area control) or asymmetric (thrust vectoring) as desired. Please note that as the effective flow

area for the primary fluid flow is controlled, the temperature and pressure of the primary gas is inherently controlled by variation of primary fluid flow velocity. The pulse cross-flow inherently controls the frequency, amplitude and wave form of the pulses. Kranz, et al teach that by employing pulsed flow, more effective deflection of the incoming flow is achieved (Col. 1, Lines 7 and following). Warren, et al teach a thrust vectoring system for a reaction engine where pulse flow (Col. 9, Lines 2 and following, especially circa Line 63) injected at the throat (e.g. Fig. 6A, 11, 121) to provide vectoring of the primary fluid. Warren also teaches that pulsed fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulse flow and the cross-flow injected by McCullough as taught by either Kranz, et al or Warren, et al to more effectively control the cross-flow penetration of McCullough, and to enhance the thrust vectoring capability. As for the nozzle being a 3-D nozzle, any nozzle can be considered in its broadest sense a 3-D nozzle as manufacturing imperfections, tolerances, distortions due to heat, operating conditions, et cetera cause deviations from an idealized case. As for temperature being controlled by decreasing the cross-sectional area, this is inherently done, as evidenced by Bernoulli's theorem.

The Applicant respectfully submits that Kranz, et al. and Warren teach the use of the Coanda effect with fluidic jet deflection by control pulses which shift the primary flow from one wall of the nozzle to another wall of the nozzle. (Kranz: column 1, lines 24-30) Kranz, et al., states that a control pulse is only necessary for the duration of the switching process. As soon as the thrust jet (primary flow) is deflected into one of the pockets shown in 16–20 (shown in Kranz Figure 1), the primary flow remains automatically and without any further control pulse under the action of the Coanda effect. (Kranz: column 1, lines 9-28)

One skilled in the art would not apply the teachings of Kranz, et al., to the present invention in that Kranz teaches according to the historical approach of shock vector control. This is applicable where a nozzle has an expansion area ratio typically between 3 to 10. Such a nozzle is widened beyond the expansion ratio corresponding to the ambient pressure. (Kranz: Column 1, lines 17-19) Throat skewing as claimed by the present invention cannot be applied to an over-expanded nozzle. Furthermore, the Applicant respectfully submits that shock vector control also cannot be applied to the small area expansion ratio nozzle as taught and claimed by the present invention. The present invention injects the secondary flow into the subsonic portion of the flow field preventing the formation of shocks which can significantly impact the nozzle's thrust efficiency. (09/621,795, page 27, lines 4-7) The Applicant respectfully submits that the

prior art does not teach skewing of the effective throat or sonic plane of a nozzle as stated in Claims 31 and 57 of the present invention.

Additionally, a nozzle's thrust efficiency is greatly increased in the present invention where one might encounter an efficiency of 9.5 when using shock vector control, one would encounter 0.9 with the small area expansion ratio nozzle claimed by the present invention.

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from any combination of McCullough and Ernst or Miller in further view of Kranz et al. or Warren. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80 as being unpatentable over McCullough in view of either Ernst or Miller et al., and allow Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80.

Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-62, 75-80, 80 stand rejected under 35 USC § 103(a) being unpatentable over the AIAA paper of Miller, et al (AIAA 95-2603) in view of McCullough. The examiner states:

> Miller, et al. teach a fixed exhaust nozzle used for gas turbine/turbofan engines (which inherently employ compressors) where the nozzle is varied by a cross-flow injected in the upstream direction (Figs. 2-5) in order to achieve a very low flow area. At the throat, the primary flow reaches the sonic condition. Miller, et al. show on the cover sheet of the paper that the flow from the primary and secondary injectors can be angled to oppose the flow. Miller, et al. do not teach thrust vectoring. However, it is clear that in a fixed nozzle, thrust-vectoring capacities are generally required in order to steer the nozzle, especially in a military aircraft. Miller, et al. further teach very low injection angles are possible (see top left of Fig. 9) and hence, as angles are very low, where angle will also be approximately parallel with the vector angle, which would also be low. McCullough teaches a nozzle has a primary flow, a primary injector 16, and a secondary injector 18, and valve controllers 22 to direct a flow to the affected flow area of the nozzle and perform thrust vectoring (top of col. 2). McCullough further teaches the use of fuel (col. 2, lines 26-28). Alternately, for the controllers, it is clear that the valves require a controller to actuate them. It would have been obvious to one of ordinary skill in the art to employ a controller in addition to the valve in order to provide the necessary control over thrust vectoring and/or throat control. It would have been obvious to one of ordinary skill in the art to both control the throat area and thrust vector, the nozzle of Miller et al., as tought by McCullough, in order to add vectoring capabilities to the nozzle of Miller et al. As for the nozzle being a 3-D nozzle, any nozzle can be considered in its broadest sense a 3-D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, etc. cause deviations from

an idealized case. As for the temperature being controlled by decreasing the cross-sectional area, this is inherently done as evidenced by Bernoulli's Theorem.

With respect to Miller, the Applicant respectfully submits that Miller, et al. fails to teach the use of an injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in independent Claims 31 and 57. Furthermore, the Applicant respectfully submits that Miller fails to teach the use of a continuously injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in Claim 31 and 57.

With respect to McCullough the applicant respectfully submits that McCullough teaches to control the effective throat of the nozzle with shock waves which form a gaseous, non-structural throat. (McCullough: Col. 2, Line 3-6) Although the examiner states that there is no requirement that the secondary injector of McCullough be located downstream of the throat. The applicant respectfully submits that the non-structural throat 24 is created by shock waves. McCullough fails to teach that injected flow may be comprise a continuous series of injected pulses as claimed in amended Claims 31 and 57. Additionally, the Applicant respectfully submits that the injectors of the present invention can be distinguished from those taught in McCullough in that the injectors of the present invention are inclined at an angle to oppose the primary flow, as stated in Claim 31 and 57, while the injectors taught by McCullough are normal to the primary flow, as shown in Figure 1. (McCullough: Figure 1, and Column 2, lines 40–50).

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from the combination of Miller and McCullough. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-62, 75-80, 80 as being unpatentable over Miller in view of McCullough, and allow Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-62, 75-80, 80.

Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, and 80 stand rejected under 35 USC Section 103.(a) as being unpatentable over the AIAA paper of Miller et al. (AIAA 95-2603) in view of McCullough (as applied above and in further view of either Kranz et al. (U.S. Patent No. 4, 351, 479) or Warren (U.S. Patent No. 3, 204, 405). The examiner states:

> Miller et al. teach various aspects of their applicant's claimed invention but it does not teach pulsing the flows nor the flows being fuel. Kranz et al. teach

a jet engine nozzle 7 injectors (a-f) spaced about the housing and valve controllers 36 associated with injectors, the controller directing injectors to provide an unsteady, i.e., pulsed, fluidic cross-flow. Pulsed cross-flow is injected to control the effective flow area, throttle and also vector the primary fluidic flow (see especially Col. 5, lines 9 and following). The pulsed cross flow partially blocks the opening of the nozzle in either the symmetric (area control) or asymmetric (cross-vectoring) as described. Please note as the effective flow area for the primary fluid flow is controlled, the temperature and pressure of the primary gas is controlled by variation of the primary fluid flow velocity. The pulse cross-flow inherently controls the frequency, amplitude and waveform of the pulses. Kranz et al. teach that by implied pulse flow, more effective deflection of the incoming flow is achieved (col. 1, line 7 and following). Miller et al. teach a thrust vectoring system for reaction engine with pulse flow (col. 9, lines 2 and following, especially circa line 63) is injected at the throat (e.g., Fig. 6A, 11, 121) to provide vectoring of the primary fluid. Warren also teach that the pulse fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulse flow the cross-flow injected by Miller et al. as taught by either Kranz et al. or Warner et al. to more effectively control the cross-flow penetration, and to enhance the thrust vectoring ability. As for the nozzle being a 3-D nozzle, any nozzle can be considered in its broadest sense a 3-D nozzle as manufacturing imperfections, tolerances, distortions due to heat, operating conditions, etc., cause deviations from an idealized face. As for the temperature being controlled by decreasing the cross-sectional area this is inherently done as evidenced by Bernoulli's Theorem.

With respect to Miller, the Applicant respectfully submits that Miller, et al. fails to teach the use of an injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in independent Claims 31 and 57. Furthermore, the Applicant respectfully submits that Miller fails to teach the use of a continuously injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in Claim 31 and 57.

With respect to McCullough the applicant respectfully submits that McCullough teaches to control the effective throat of the nozzle with shock waves which form a gaseous, non-structural throat. (McCullough: Col. 2, Line 3-6) Although the examiner states that there is no requirement that the secondary injector of McCullough be located downstream of the throat. The applicant respectfully submits that the non-structural throat 24 is created by shock waves. McCullough fails to teach that injected flow may be comprise a continuous series of injected pulses as claimed in amended Claims 31 and 57. Additionally, the Applicant respectfully

submits that the injectors of the present invention can be distinguished from those taught in McCullough in that the injectors of the present invention are inclined at an angle to oppose the primary flow, as stated in Claim 31 and 57, while the injectors taught by McCullough are normal to the primary flow, as shown in Figure 1. (McCullough: Figure 1, and Column 2, lines 40–50).

With respect to Kranz, et al. and Warren, the Applicant respectfully submits that Kranz, et al. and Warren teach the use of the Coanda effect with fluidic jet deflection by control pulses which shift the primary flow from one wall of the nozzle to another wall of the nozzle. (Kranz: column 1, lines 24-30) Kranz, et al., states that a control pulse is only necessary for the duration of the switching process. As soon as the thrust jet (primary flow) is deflected into one of the pockets shown in 16–20 (shown in Kranz Figure 1), the primary flow remains automatically and without any further control pulse under the action of the Coanda effect. (Kranz: column 1, lines 9-28)

One skilled in the art would not apply the teachings of Kranz, et al. and Warren, to the present invention in that Kranz and Warren teach according to the historical approach of shock vector control. Kranz and Warren fail to teach the use of pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in independent Claims 31 and 57. Furthermore, the Applicant respectfully submits that Kranz and Warren fail to teach the use of a continuously injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in Claim 31 and 57. Rather, Kranz and Warren merely teach that a non-continuous shock may be used to shift the primary flow from following along one surface of the nozzle to another surface of the nozzle.

This is applicable where a nozzle has an expansion area ratio typically between 3 to 10. Such a nozzle is widened beyond the expansion ratio corresponding to the ambient pressure. (Kranz: Column 1, lines 17-19) Throat skewing as claimed by the present invention cannot be applied to an over-expanded nozzle. Furthermore, the Applicant respectfully submits that shock vector control also cannot be applied to the small area expansion ratio nozzle as taught and claimed by the present invention. The present invention injects the secondary flow into the subsonic portion of the flow field preventing the formation of shocks which can significantly impact the nozzle's thrust efficiency. (09/621,795, page 27, lines 4-7) The Applicant respectfully submits that the prior art does not teach skewing of the effective throat or sonic

plane of a nozzle as stated in Claims 31 and 57 of the present invention. Rather, the prior art merely teaches that a non-continuous shock may be used to shift the primary flow from following along one surface of the nozzle to another surface of the nozzle.

Additionally, a nozzle's thrust efficiency is greatly increased in the present invention where one might encounter an efficiency of 9.5 when using shock vector control, one would encounter 0.9 with the small area expansion ratio nozzle claimed by the present invention.

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from the combination of Miller and McCullough in further view of Kranz or Warren. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, and 80 as being unpatentable over Miller in view of McCullough in further view of Kranz or Warren, and allow Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, and 80.

Claims 78 and 80 stand rejected under 35 USC, Section 103(a) as being unpatentable over any of the above combinations as applied above and further in view of either Terrier (5,665,415) or Justice (6,000,635). The examiner states:

> The above prior teach the various aspects of applicant's claimed invention but do not specifically teach a three-dimensional fixed nozzle. Terrier teaches (Fig. 8) that 3-D fixed nozzles, including ultra high aspect ratio biconvex aperture nozzles are old and well known in the fixed nozzle art. Justice teaches that it is old and well known to employ a 3D fixed nozzle fixed nozzle art with an ultra high aspect ratio trapezoid aperature nozzle 33B (col. 2, circa line 63) is old and well known in the fixed nozzle art. It would have been obvious to one of ordinary skill in the art employ a 3-D nozzle, including either an ultra-high aspect ratio biconvex aperture nozzle as well as known types of fixed nozzles utilized in the art.

The applicant respectfully submits that amended Claims 78 and 80 inject fluidic pulses with the plurality of primary injectors. The applicant respectfully submits that the instant application can be distinguished from a prior art of Terrier and Justice by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area of the flow. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier or Justice, rather only a steady state injection into a primary fluidic flow. Thus Terrier and Justice in fact do not disclose and teach away from the unsteady fluidic pulse of the present invention.

Therefore, applicant respectfully request the Examiner withdraw the rejections under 35 USC § 103, and allow Claims 78 and 80.

Claim 80 stands rejected under 45 U.S.C. § 103(a) as being unpatentable over Rich (2,952,123) in view of either Terrier or Justice. The examiner states:

> Rich teaches a system for vectoring a primary flow comprising: a nozzle having an inner surface and a throat (Fig. 4) wherein the throat comprises a region within the nozzle of lowest cross-section area, throat being in a path of primary flow of fluid; a plurality of primary injectors 77 arranged along the inner surface of the nozzle, the plurality of primary injectors are indivisually arranged to oppose the primary flow of fluid (see Fig. 5 and Col. 3, line 25-28 for varying the angle to oppose the flow) in a first intended vectoring plane, and wherein the primary injectors skew an effective throat or sonic plane within said nozzle. Rich does not teach the nozzle is a 3D nozzle but does teach the illustrated nozzle configuration is non-limiting (Col. 5, lines 48-54). Terrier teach a 3-D nozzle (See Fig. 6-9 where the 3-D aspect is readily apparent) having primary injectors 24 opposed to primary flow in the throat. It would have been obvious to one of ordinary skill in the art to employ a 3D nozzle for the nozzles of Rich as a well-known type of nozzle that requires thrust vectoring.

With respect to Rich, the applicant respectfully submits that Rich teaches the use of cross flow injectors to inject fuel into the primary flow. Rich makes no mention that of an effective throat which may be varied in size, shape or orientation. Rather, Rich mentions that "supplemental fuel is injected in a direction in which the primary jet stream is to be deflected. … It is important to observe that energy of the supplemental fuel thus introduced into the primary jet stream … add appreciable energy to the thrust producing stream." (Col. 6, lines 24+) The applicant therefore submits that the present invention can be distingusied from Rich, as the present invention varies an effective throat in size, shape or orientation to vector the primary flow while Rich adds substantial energy to vector the primary flow.

The applicant respectfully submits that the instant application can be distinguished from a prior art of Terrier and Justice by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area of the flow. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier or Justice, rather only a steady state injection into a primary fluidic flow. Thus Terrier and Justice in fact do not disclose and teach away from the unsteady fluidic pulse of the present invention.

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from the combination of Rich and Terrier or Justice. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claim 80 as being unpatentable over Rich in view of Terrier or Justice, and allow Claim 80.

Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-61, 75, 77, 78 and 80 stand rejected under 35 USC Section 103.(a) as being unpatentable over Terrier in view or either Rich or Ernst and optionally McCullough. The examiner states:

> Terrier teaches a system for vectoring a primary flow comprising: a 3-D nozzle (See Fig. 6-9 where the 3-D aspect is readily apparent)having an inner surface and a throat, wherein the throat comprises a region within the 3-D nozzle of lowest cross-section area, the throat being in a path of primary flow of fluid; a plurality of primary injectors arranged along the inner surface of the 3-D nozzle, the plurality of primary injectors 24 are individually arranged to oppose the primary flow of fluid in a first intended vectoring plain, and wherein said primary injectors skew an effective throat or sonic plain within said 3-D nozzle. Terrier does not teach additional secondary injectors downstream of the primary injectors to skew the throat or sonic plain. Rich teaches secondary injectors 23 (Fig. 6) downstream of the throat to skew the throat or sonic plain and also teaches the use of fuel. Ernst teaches that it was old and well-known in the thrust vectoring art to employ primary and secondary injectors 1,3 that are either angled perpendicular to the primary flow (Fig. 1) or inclined to oppose the flow (Fig. 3) and shows that the effective vector "O" can be increased by using opposed flow (Compare Fig. 3 to Fig. 1). McCullough is applied as a teaching reference that teaches that having primary and secondary injectors allows for greater flow control to control the effective throat and thrust vectoring and also teaches the use of fuel. It would also have been obvious to one of ordinary skill in the art to employ secondary injectors with Terrier to better control the effective throat or sonic plain thrust vector. The use of a controller is taught (Col. 6, lines 54+).

With respect to Terrier, the applicant respectfully submits that the amended Claims are operable to continuously inject fluidic pulses with the plurality of primary injectors. The applicant respectfully submits that the instant application can be distinguished from a prior art of Terrier and by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area, shape and orientation of the flow. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier, rather only a steady state injection into a primary fluidic flow. Thus Terrier in fact does not disclose and teaches away from the ability continuously inject varying fluidic pulses to control

the cross-sectional area, shape and orientation of the effect throat as claimed in the present invention.

With respect to Rich, the applicant respectfully submits that Rich teaches the use of cross flow injectors to inject fuel into the primary flow. Rich makes no mention of an effective throat which may be varied in size, shape or orientation to vector the primary flow. Rather, Rich mentions that "supplemental fuel is injected in a direction in which the primary jet stream is to be deflected. ... It is important to observe that energy of the supplemental fuel thus introduced into the primary jet stream ... add appreciable energy to the thrust producing stream." (Col. 6, lines 24+) The applicant therefore submits that the present invention can be distingusied from Rich, as the present invention varies an effective throat in size, shape or orientation to vector the primary flow while Rich adds substantial energy to vector the primary flow.

With respect to Ernst, the Applicant respectfully submits that Ernst fails to teach the use of an injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in the amended Claims.

With respect to McCullough, the applicant respectfully traverses the examiners use of McCullough as a teaching reference. The applicant respectfully submits that McCullough teaches to control the effective throat of the nozzle with shock waves which form a gaseous, non-structural throat. (McCullough: Col. 2, Line 3-6) The applicant respectfully submits that the non-structural throat 24 is created by shock waves. McCullough fails to teach that injected flow may be comprise a continuous series of injected pulses as claimed in the amended Claims to control the size, shape and orientation of the effective throat. Additionally, the Applicant respectfully submits that the injectors of the present invention can be distinguished from those taught in McCullough in that the injectors of the present invention are inclined at an angle to oppose the primary flow, as stated in Claim 31 and 57, while the injectors taught by McCullough are normal to the primary flow, as shown in Figure 1. (McCullough: Figure 1, and Column 2, lines 40–50).

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from the combination of Terrier in view of Rich or Ernst and optionally McCullough. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-61, 75, 77, 78 and 80 as being unpatentable over

Terrier in view of Rich or Ernst and optionally McCullough, and allow Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-61, 75, 77, 78 and 80.

Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, and 80 stand rejected under 35 U.S.C. § 103(a) as being unpatentable under Terrier in view of either Rich or Ernst and optionally McCullough as applied above and further in view of Kranz, et al. or Warren. The examiner states:

> Krans, et al. teach that by employ pulsed flow, more effective defelection of the incoming flow is achieved (col. 1, line 7 and following). Warner et al. teaches a broad vectoring system for reactive **** or pulse (Col. 9, lines 2 and 4 and especially the second line) is injected at the throat (e.g. Fig. A, 11, 121) provides vectoring of the primary fluid. Warren et al. teach a thrust vectoring system for a reaction engine where pulsed flow (col. 9, lines 2 and following, especially circa line 63) is injected at the throat (e.g. Fig. 6A, 11, 121) to provide vectoring of the primary fluid. Warren also teach that the pulsed fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulsed flow of the cross flow injected by McCullough as taught by either Krans, et al. or Warner to more effectively control the cross flow penetration of McCullough, and to enhance the thrust vectoring ability. As for the temperature being controlled by decreasing the cross-sectional area, this is inherently done as evidenced by Bernoulli's Theorem.

With respect to Terrier, Rich or Ernst and optionally McCullough, the applicant respectfully traverses the examiners arguments as stated above. The applicant respectfully submits that the amended Claims are operable to continuously inject fluidic pulses with the plurality of primary injectors. The applicant respectfully submits that the instant application can be distinguished from a prior art of Terrier and by pulsing and varying the injected flow to produce a larger degree of control over the cross-sectional area, shape and orientation of the flow. By pulsing the injected flow, a greater penetration of the primary fluid flow is achieved. This pulsing was not taught in Terrier, rather only a steady state injection into a primary fluidic flow. Thus Terrier in fact does not disclose and teaches away from the ability continuously inject varying fluidic pulses to control the cross-sectional area, shape and orientation of the effect throat as claimed in the present invention.

With respect to Rich, the applicant respectfully submits that Rich teaches the use of cross flow injectors to inject fuel into the primary flow. Rich makes no mention of an effective throat which may be varied in size, shape or orientation to vector the primary flow. Rather, Rich

mentions that "supplemental fuel is injected in a direction in which the primary jet stream is to be deflected. ... It is important to observe that energy of the supplemental fuel thus introduced into the primary jet stream ... add appreciable energy to the thrust producing stream." (Col. 6, lines 24+) The applicant therefore submits that the present invention can be distingusied from Rich, as the present invention varies an effective throat in size, shape or orientation to vector the primary flow while Rich adds substantial energy to vector the primary flow.

With respect to Ernst, the Applicant respectfully submits that Ernst fails to teach the use of an injected pulsed cross flow to control the size, location, and orientation of the effective throat or sonic plane of the nozzle as claimed by the present invention in the amended Claims.

With respect to McCullough, the applicant respectfully traverses the examiners use of McCullough as a teaching reference. The applicant respectfully submits that McCullough teaches to control the effective throat of the nozzle with shock waves which form a gaseous, non-structural throat. (McCullough: Col. 2, Line 3-6) The applicant respectfully submits that the non-structural throat 24 is created by shock waves. McCullough fails to teach that injected flow may be comprise a continuous series of injected pulses as claimed in the amended Claims to control the size, shape and orientation of the effective throat. Additionally, the Applicant respectfully submits that the injectors of the present invention can be distinguished from those taught in McCullough in that the injectors of the present invention are inclined at an angle to oppose the primary flow, as stated in Claim 31 and 57, while the injectors taught by McCullough are normal to the primary flow, as shown in Figure 1. (McCullough: Figure 1, and Column 2, lines 40–50).

The Applicant respectfully submits that Kranz, et al. and Warren teach the use of the Coanda effect with fluidic jet deflection by control pulses which shift the primary flow from one wall of the nozzle to another wall of the nozzle. (Kranz: column 1, lines 24-30) Kranz, et al., states that a control pulse is only necessary for the duration of the switching process. As soon as the thrust jet (primary flow) is deflected into one of the pockets shown in 16–20 (shown in Kranz Figure 1), the primary flow remains automatically and without any further control pulse under the action of the Coanda effect. (Kranz: column 1, lines 9-28)

One skilled in the art would not apply the teachings of Kranz, et al., to the present invention in that Kranz teaches according to the historical approach of shock vector control. This is applicable where a nozzle has an expansion area ratio typically between 3 to 10. Such a

nozzle is widened beyond the expansion ratio corresponding to the ambient pressure. (Kranz: Column 1, lines 17-19) Throat skewing as claimed by the present invention cannot be applied to an over-expanded nozzle. Furthermore, the Applicant respectfully submits that shock vector control also cannot be applied to the small area expansion ratio nozzle as taught and claimed by the present invention. The present invention injects the secondary flow into the subsonic portion of the flow field preventing the formation of shocks which can significantly impact the nozzle's thrust efficiency. (09/621,795, page 27, lines 4-7) The Applicant respectfully submits that the prior art does not teach skewing of the effective throat or sonic plane of a nozzle as stated in Claims 31 and 57 of the present invention.

Additionally, a nozzle's thrust efficiency is greatly increased in the present invention where one might encounter an efficiency of 9.5 when using shock vector control, one would encounter 0.9 with the small area expansion ratio nozzle claimed by the present invention.

Thus, the Applicant respectfully submits that one cannot reach the claimed invention from any combination of Terrier, in view of Rich or Ernst and optionally McCullough and in further view of Kranz et al. or Warren. Therefore, the Applicant respectfully requests that the Examiner withdraw the § 103 rejections to Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80 as being unpatentable over Terrier, in view of Rich or Ernst and optionally McCullough and in further view of Kranz et al. or Warren., and allow Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80.

Applicant respectfully points out that in order to combine references for an obviousness rejection, there must be some teaching, suggestion or incentives supporting the combination. *In re Laskowski*, 871 F.2d 115, 117, 10 U.S.P.Q. 2d 1397, 1399 (Fed. Cir. 1989). The mere fact that the prior art could be modified does not make that modification obvious unless the prior art suggests the desirability of the modification. *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984). In addition, it is well established that Applicant's disclosure cannot be used to reconstruct Applicant's invention from individual pieces found in separate, isolated references. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q. 2d 1596 (Fed. Cir. 1988).

Applicant respectfully submits that there is no motivation, teaching or suggestion for any combination of Terrier, Rich, Ernst, Miller, McCullough, Kranz et al. and Warren. Therefore, the rejection on a combination of these references is inappropriate. Withdrawal of the rejection allowance of all pending Claims is respectfully requested.

Additional Claims

Claims 83-86 have been added to more particularly claim the invention with regard to the above stated limitations. Specifically, Claims 85 and 86 claim a three-dimensional (3D) small area expansion nozzle operable to dynamically control a direction and magnitude of a primary flow by varying a shape, cross-sectional area, or orientation of an effective throat or sonic plane within the 3D small area expansion nozzle. 3D arrays of primary injectors within the convergent portion of the 3D small area expansion nozzle and 3D arrays of secondary injectors downstera, of the primary injectors are inclined to oppose the primary flow up-stream of the effective throat or sonic plane and located within a surfaces of the 3D small area expansion nozzle. The primary and secondary injectors are operable to continuously inject varying fluidic pulses. These fluidic pulses in turn are operable to vary the shape, cross-sectional area, or orientation of the effective throat or sonic plane within the 3D small area expansion nozzle. This manipulation of the effective throat or sonic plane allows the manipulation of the magnitude and direction of the primary flow exiting the divergent portion of the nozzle.

CONCLUSION

Applicants have now made an earnest attempt to place this case in condition for allowance. For the foregoing reasons, and for other reasons clearly apparent, Applicants respectfully request full allowance of the pending claims.

An extension of three (3) months is requested and a Notification of Extension of Time Under 37 C.F.R. § 1.136 with the appropriate fee is attached hereto

It is believed no additional fees are due with this submission, however, should any fees be determined to be due, the Commissioner is hereby authorized to charge any fees or credit any overpayments to Koestner Bertani LLP Deposit Account No. 50-2240.

Respectfully submitted,

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